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# COMPARATIVE ANALYSIS OF PTERYGIUM CLINICAL CHARACTERISTICS

**SUMMARY**

**The aim of the research was to investigate the mutual relatedness of the clinical characteristics of pterygium (duration of the disease, size, grade, presence of Fuchs' patches and recurrence) and to point to the possibility of predicting the recurrence.**

**For the purpose of research, a group of 55 patients with pterygium was recruited. The patients were operated using the technique by Arlt at the Ophthalmology Clinic in Nis, where a complete clinical examination was also performed. Anamnestic data were collected preoperatively. The size of external scum was measured with a millimeter scale ruler and Tan's biomicroscopic method was used to verify the grade. In order to observe the complications and recurrence, all patients were monitored postoperatively for one year.**

**Pterygium represents a slow-growing formation which is confirmed by a high statistical significance ($p < 0.001$) of a correlation between its size and duration of development. Along with the growth of pterygium, its grade also increases. The reported difference in size between the two farthest grades – I and III has statistical significance ($p < 0.001$). Statistically, Fuchs' patches are more often present ($p < 0.05$) in larger pterygia. Compared to other factors, the presence of Fuchs' patches in pterygia increases the relative risk of recurrence by 6.62 times.**

**A comparative analysis of clinical characteristics of pterygium is a good basis for predicting the recurrence, which represents the greatest problem in the treatment of this widespread disease.**

*Key words:* **pterygium, Fuchs' patches, eye**

## INTRODUCTION

Due to its tendency to recur and so far unfamiliar etiology, pterygium internum still represents a significant problem in modern, everyday ophthalmology practice. Among the possible etiological factors which may cause the occurrence of pterygium, the literature reports the following: ultraviolet (UV) radiation (1-4), chronic eye inflammation, toxic reactions of chemical substances, irritable reactions of wind, dust, smoke and polluted air. Lately, viruses have also been mentioned as possible etiological factors (5). Pterygium is also regarded as a neoplastic change (2,6,7) .

The destructive effect of UV radiation decreases the number of the stem cells of corneal limbus, i.e. causes limbal insufficiency. It activates the tissue growth factors which induce angiogenesis and cell proliferation (8-10).

The clinical image of external scum was familiar even at the times of Hippocrates, Galen and Celsus. Today, it is a triangular duplicature of a

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modified tissue of bulbar conjunctiva which, starting from the nasal side, overgrows the internal edge of the cornea, destroys the Bowman's membrane and penetrates deeply into the cornea. Pterygium consists of the head (part of pterygium which affects the cornea), the neck (with indistinct borders, situated on corneal limbus, between the head and body) and the body (a wide part of pterygium situated in the area of sclera). Pterygium resembles a wing of pterygoid insects and therefore acquires its name which is of Greek origin (*Greek*, pterigos – wing) (11,12).

There are certain difficulties concerning the precise quantification of the clinical appearance of pterygium. The simplest method is measuring the length of fibrovascular stroma of pterygium which overhangs the cornea (13).

Tan et al. (14) provided a morphological classification of pterygium based on its relative transparency under the microscope. They classified pterygium into three groups. The first group (grade I) is composed of atrophic pterygia, whose episcleral blood vessels, situated under the body of pterygium, are clearly visible i.e. unobscured. The second group (grade II) consists of intermediate pterygium which is located between atrophic and fleshy pterygium. The third group (grade III) consists of fleshy pterygia with episcleral vessels completely obscured.

Another and more precise method is photographing the pterygium with a high resolution digital camera. Using NIH Image software it would be possible to measure the details on the obtained photograph (13).

The most precise method of quantitative measuring of pterygium's diameter is computerized videokeratography (corneal topography). It is primarily used for obtaining a profile map of the front surface of cornea (13).

The aim of the research was to investigate the mutual relatedness of clinical characteristics of pterygium and, based on their analysis, to point to the possibility of predicting the recurrence.

## MATERIAL AND METHODS

The research included 55 patients with pterygium, who were operated using the technique by Arlt. Anamnestic data were collected and complete opthalmological examinations were performed preoperatively. The clinical examination included measuring the size of external scum of the eye with a millimeter scale ruler and the grade was verified using a method by Tan et al. (14). In order to observe the complications and recurrence of the disease, all patients were monitored postoperatively for one year.

The obtained results were statistically analyzed by a statistical program package – Statistical Package for Social Science (SPSS) software, version 11. The methods of descriptive statistics depended on the tested markers: mean value ($X\square$); parametric: Student's t-test, and non-parametric tests: $\chi^2$-test and Mann-Whitney test (M-W); 95% of confidence interval; Pearson's test of bivariate correlation and multivariate regression analysis.

## RESULTS

The results of comparative analysis of size and duration of pterygium are displayed in *Table 1*. The size of pterygium was was in positive correlation with duration, with high statistical significance ($p < 0.001$), which was confirmed by Pearson's test of bivariate correlation ($R = 0.463$).

*Table 1. Size and duration of pterygium*

| DURATION | SIZE | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | 1 – 2 mm | | 3 – 4 mm | | 5 – 6 mm | | |
| | № | % | № | % | № | % | |
| 1 – 5 years | 19 * | 90.4 | 7 | 33.3 | 5 | 38.4 | 31 |
| 6 – 10 years | 1 | 4.8 | 8 | 38.1 | 4 | 30.8 | 13 |
| > 10 years | 1 | 4.8 | 6 | 28.6 | 4 | 30.8 | 11 |
| TOTAL | 21 | 100 | 21 | 100 | 13 | 100 | 55 |

** p < 0.001*

The results of comparative analysis of size and grade of pterygium are displayed in *Table 2*. The grade of pterygium was directly proportionate to its size, i.e. higher grade pterygiums had a larger size which was confirmed by Pearson's test of bivariate correlation ($R = 0.535$; $p < 0.001$). The difference obtained by Student's t-test was statistically highly significant only between grades I and III ($t = 4.683$; $p < 0.001$) and between grades II and III ($t = 2.655$; $p < 0.05$).

*Table 2. Size and grade of pterygium*

| GRADE | SIZE | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | 1 – 2 mm | | 3 – 4 mm | | 5 – 6 mm | | |
| | № | % | № | % | № | % | |
| * I | 11 | 52.4 | 4 | 19.0 | 1 | 7.7 | 16 |
| II ** | 6 | 28.6 | 3 | 14.3 | 1 | 7.7 | 10 |
| * III ** | 4 | 19.0 | 14 | 66.7 | 11 | 84.6 | 29 |
| TOTAL | 21 | 100 | 21 | 100 | 13 | 100 | 55 |

** p < 0.001 ** p < 0.05*

The results of comparative analysis of the size of pterygium and presence of progression zones (Fuchs' patches) are shown in *Table 3*. The average size of pterygium in patients with Fuchs' patches was 4.1 mm, whereas in patients without Fuchs' patches, the size of pterygium was 3.2 mm. The difference was statistically significant ($t = 2.332$; $p < 0.05$).

*Table 3. Size of pterygium and presence of Fuchs' patches*

| FUCHS' PATCHES | SIZE | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | 1 – 2 mm | | 3 – 4 mm | | 5 – 6 mm | | |
| | № | % | № | % | № | % | |
| YES | 5 | 23.8 | 6 | 28.6 | 8 | 61.5 | 19 |
| NO | 16 * | 76.2 | 15 | 71.4 | 5 | 38.5 | 36 |
| TOTAL | 21 | 100 | 21 | 100 | 13 | 100 | 55 |

** p < 0.05*

The results of comparative analysis of the grade and duration of pterygium are shown in *Table 4*. The average duration of pterygium in patients with grade I was 5.37 years, in patients with grade II pterygium it was 5, 40 years and in patients with grade III pterygium the duration was 8, 41 years. Although there was a positive correlation between the duration of external eye scum and the grade, it had no statistical value ($p > 0.05$). Observing the duration of low grade pterygia (grade I and II) and duration of the highest grade pterygia (grade III), it could be seen that there existed a statistically significant difference in duration of pterygia in patients belonging to these two groups, which was confirmed by Student's t-test ($t = -2.110$; $DF = 53$; $p < 0.05$). Mean duration of low-grade pterygium (unified grades I and II) was 5.38 years, ($SD = 4.5$; $SE = 0.89$), whereas in grade III pterygia it was 8.41 years ($SD = 5.88$; $SE = 1.09$). Finally, it can be said that high grade pterygium lasted longer.

*Table 4.Grade and duration of pterygium*

| DURATION | GRADE | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | I | | II | | III | | |
| | № | % | № | % | № | % | |
| 1 – 5 years | 12 | 75.0 | 6 | 60.0 | 13 | 44.8 | 31 |
| 6 – 10 years | 3 | 18.7 | 3 | 30.0 | 7 | 24.1 | 13 |
| > 10 years | 1 | 6.3 | 1 | 10.0 | 9 | 31.1 | 11 |
| TOTAL | 16 | 100 | 10 | 100 | 29 | 100 | 55 |

*p > 0.05*

The results obtained by comparative analysis of pterygium grades and the presence of Fuchs' patches are shown in *Table 5*. There was a statistically significant difference between grades and presence of Fuchs' patches in operated patients, in other words, Fuchs' patches were most commonly found in patients with grade III pterygium, as was confirmed by Mann-Whitney test ($M\text{-}W\text{-}179.50$; $p < 0.05$).

*Table 5. Pterygium grades and the presence of Fuchs' patches*

| FUCHS' PATCHES | GRADE | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|
| | I | | II | | III | | |
| | № | % | № | % | № | % | |
| YES | 2 | 12,5 | 1 | 10,0 | 16 * | 55,17 | 19 |
| NO | 14 | 87,5 | 9 | 90,0 | 13 | 44,83 | 36 |
| TOTAL | 16 | 100 | 10 | 100 | 29 | 100 | 55 |

** p < 0.05*

*Table 6* shows the results of comparative analysis of the presence of Fuchs' patches and duration of pterygium. The disease lasted for 8.3 years in patients with Fuchs' patches and 6.3 years in patients without Fuchs' patches. The difference was not statistically significant ($t = 1.320$; $p > 0.05$).

*Table 6. Presence of Fuchs' patches and duration of pterygium*

| DURATION | FUCHS' PATCHES | | | | TOTAL |
|---|---|---|---|---|---|
| | YES | | NO | | |
| | № | % | № | % | |
| 1 – 5 years | 9 | 47.4 | 22 | 55.6 | 31 |
| 6 – 10 years | 4 | 21.1 | 9 | 25.0 | 13 |
| > 10 years | 6 | 31.5 | 5 | 13.9 | 11 |
| TOTAL | 19 | 100 | 36 | 100 | 55 |

*p > 0.05*

The results of comparative analysis of recurrence in operated patients and duration of pterygium are displayed in *Table 7*. In patients with recurrence, mean duration of the disease was 4.7 years, whereas in patients without recurrence it lasted for 7.3 years. The observed difference had no statistical significance ($t = 1.25$; $p > 0.05$).

*Table 7. Recurrence and duration of pterygium*

| DURATION | RECURRENCE | | | | TOTAL |
|---|---|---|---|---|---|
| | DA | | NE | | |
| | № | % | № | % | |
| 1 – 5 years | 6 | 75.0 | 25 | 53.2 | 31 |
| 6 – 10 years | 1 | 12.5 | 12 | 25.5 | 13 |
| > 10 years | 1 | 12.5 | 10 | 21.3 | 11 |
| TOTAL | 8 | 100 | 47 | 100 | 55 |

*p > 0.05*

The results of comparative analysis of recurrence and size of pterygium are shown in *Table 8*. Average size of pterygium in patients with recurrence was 3.6 mm, while in patients without recurrence it was 3.4 mm. It was confirmed by t-test that the difference was not statistically significant ($t = 0.275$; $DF = 53$; $p > 0.05$).

*Table 8. Recurrence and size of pterygium*

| SIZE | RECURRENCE | | | | TOTAL |
|---|---|---|---|---|---|
| | YES | | NO | | |
| | № | % | № | % | |
| 1 – 2 mm | 2 | 25.0 | 19 | 40.5 | 21 |
| 3 – 4 mm | 5 | 62.5 | 16 | 34.0 | 21 |
| 5 – 6 mm | 1 | 12.5 | 12 | 25.5 | 13 |
| TOTAL | 8 | 100 | 47 | 100 | 55 |

*p > 0.05*

*Table 9* shows the results of comparative analysis of recurrence and grade of pterygium. Even though average grade was higher in patients with

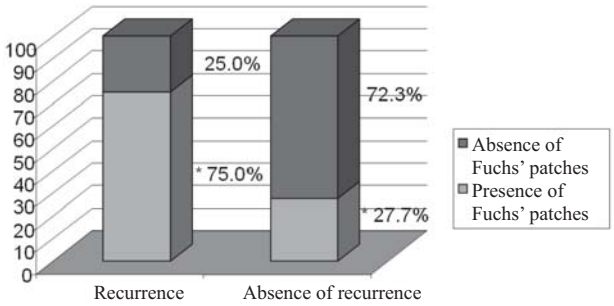
recurrence, the difference obtained by Mann-Whitney test had no statistical significance (M-W = 116; p > 0.05).

*Table 9. Recurrence and grade of pterygium*

| GRADE | RECURRENCE | | | | TOTAL |
|---|---|---|---|---|---|
| | YES | | NO | | |
| | № | % | № | % | |
| I | 1 | 12.5 | 15 | 31.9 | 16 |
| II | 0 | 0 | 10 | 21.3 | 10 |
| III | 7 | 87.5 | 22 | 46.8 | 29 |
| TOTAL | 8 | 100 | 47 | 100 | 55 |

*p > 0.05*

The results of comparative analysis of recurrence and presence of Fuchs' patches are shown in *Figure 1*.




** p < 0.05*

*Figure 1. Recurrence - Presence of Fuchs' patches*

The results of multivariate regression analysis of recurrence in operated patients are shown in *Table 10*. A dependant variable was the presence or absence of recurrence, whereas independent variables were all statistically significant differences between the two groups.

According to multivariate logistic regression, the presence of Fuchs' patches (B = 1.8901; RR = 6.6198) represent the risk factor of recurrence.

*Table 10. Multivariate logistic regression*

| PARAMETER | MULTIVARIATE LOGISTIC REGRESSION | | | |
|---|---|---|---|---|
| | B | S.E. | SIG | RR |
| Presence of Fuchs' patches | 1.8901 | 0.9738 | 0.0523 | 6.6198 |

## DISCUSSION

According to the findings of various researches, there are individual data about the size of pterygium and the period of development of examined pterygia. Still, available literature has no information about their mutual correlation. According to our results, high statistical significance (p < 0.001) in a correlation between the two mentioned factors, classifies pterygium as a slow growing formation which might be said to have a linear growth factor. Even though its growth is almost unnoticeable to patients, taking into account the high statistical significance, it could be said that the size of pterygium is an indicator of the duration of disease. The high statistical significance also points to a relative precision of sampling the data related to the two clinical features. This might indicate that the more precise measuring of the external eye scum, along with the use of a larger, statistically valid sample, could help obtain a function expressed in a graph, according to which it would be possible to determine the duration of the disease based on its size (expressed in mm), and without anamnestic data. One possible way is to use a digital camera to photograph a great number of patients during the clinical examination, and then determine the size of pterygium using a photographic analysis software. This would help create a valid database. Anamnestic data concerning the duration of the disease would be added to the database and, according to these data, it would be possible to set the correlations.

Along with the growth in size, pterygium also exhibits a growth in grade. The obtained difference in size is statistically significant (p < 0.001) between the two farthest grades – I and III. There is a less significant difference between grade II and grade III, and no perceived difference between grade I and grade II. Such a statistical relation could point to a linear relationship between the increase in grade and the growth in size of pterygium. We used a gradation according to Tan et al.(14) which is related to qualifying the reduction of transparency of pterygial tissue. It could be presumed that the growth in size of pterygium results from the production of the newly formed connective tissue, in other words a formation of an inexpedient binder (which may contain different amounts of bound water) over and around episcleral blood vessels. Finally, such growth of pterygium leads to an increase in grade.

It is interesting to note that Verma et al.(15) used the size of pterygium, measured from the limbus, as a grading parameter with the following classification: grade I (0-2 mm); grade II (3-4 mm); grade III (>4 mm). Taking into account our statistically confirmed match between the increase in size and grade of pterygium, it might be said that the grading published by Tan et al. (14) and Verma et al. (15) is, by simple analogy, very close to ours.

Based on the stated results, it could be presumed that the evolution of pterygium is slower in its early phases (grade I and grade II), whereas changes in later phases of the disease (grade III) are much faster. It is possible that the observed difference is manifested by a more rapid growth of pterygium, and thus by the size measured at the moment of surgical intervention.

Available literature provides no information about the islets of progression and their relation to the size and progress of pterygium. Our results, confirmed by statistically significant difference ($p < 0.05$), show that pterygia, with islets of progression, are bigger than those in which no islets of progression are present. A higher rate of progression islets in larger pterygia, which are, though rarely, also present in smaller pterygia, points to the possibility of spreading of pterygial tissue towards the center of cornea. A more common appearance of progression islets in larger pterygia can be associated to the fact that pterygium has reached its critical mass and therefore a change in its development occured, i.e. the tempo of its growth increased. Since progression islets, defined by Busaka (12) as signs of progression, also appear in smaller pterygia, it can be considered that those pterygia which display the mentioned morphological characteristic are progressive in type, which will be clarified in the discussion on the recurrence of the disease.

Although there is a tendency towards an increase in the duration of pterygium along with an increase in grade, it did not show any statistical significance. However, grade III with its longer evolution stands out as a separate category. It is interesting to point out that the grade of pterygium, in our earlier mentioned results, was related to the size of pterygium which was also connected to the duration of the disease.

The high, statistically significant ($p = 0.002$) association between the presence of progression islets and grade III confirms the presumptions that grade III stands out as a separate nosologic category in the progression of pterygium. Grade III, as a clinical parameter, has the lowest transparency for episcleral blood vessels. This is probably the consequence of a specific organization, more precisely disorganization, of its connective tissue. In addition, such organization is a part of morphologic manifestations of specific biological characteristics of pterygium at this level of development.

Observing the connection between Fuchs' patches and other clinical parameters, it was perceived that they are more often present in patients with longer evolution of the disease. Also, it was seen that their presence has statistically more significant correlation only to the highest grade, size of pterygium and its recurrence.

Although Fuchs' patches (islets) are not included in the system of gradation we have used, their presence showed significant connection to the size and grade of the examined pterygia. As it can be seen from the results, Fuchs' patches are most common in grade III patients, who also had the largest pterygia, as opposed to the patients with no Fuchs' patches. It might be concluded that the presence of Fuchs' patches represents a part of a slow development in a clinical picture of pterygium.

In any case, it is certain that Fuchs' patches have, for a long period of time, justifiably presented one of the most significant clinical characteristics in assessing the progression of pterygium.

Average duration of pterygium in patients with recurrence was shorter, compared to patients without recurrence. This result could be interpreted by individual predestination to the development of pterygium, namely its recurrence. However, due to deficiency of data in available literature, the mentioned mutual correlation can be discussed only in academic circles.

It can be said that the size of pterygium has no influence on recurrence and does not present a risk factor of its appearance. In our sample, the greatest number of operated patients with recurrence belonged to a group with a medium size pterygium (3-4 mm). This information bears no statistical significance because of a small number of patients with recurrence.

It is obvious that the grade of pterygium, as a macroscopic indicator of the quality of pterygial binding tissue has higher values in patients with recurrence of the disease, even though these values are on the border of statistical significance.

Recurrence of pterygium is associated with its morphology (clinical), and it is the fleshiness of pterygium (decrease of transparency- third stage: atrophic, intermedial, and fleshy), not the age of patients, which represents a highly significant risk factor of recurrence after an operation of the 'bare sclera'. Conjunctival autografting of primary and recurrent pterygia is effective in reducing the recurrence of pterygia, as opposed to the bare sclera excision (14).

Based on the data shown in Figure 1, it can be observed that the presence of Fuchs' patches is significant in 75% of patients with recurrence after the surgical treatment of pterygium. This might confirm their prognostic significance of the pathology of pterygium, which was explored by Busaka (12) in his study.

Statistically, Fuchs' patches are significantly related to recurrence. More than any other factor, their appearance in pterygium increases the relative risk of recurrence by 6.62 times, which has been confirmed by multivariate regression analysis.

## CONCLUSION

An increase in size of pterygium is in a positive correlation with longer evolution, development of external eye scum, and this relation has high statistical significance. An increase in grade of external eye scum is followed by growth in its size.

An average size of the external eye scum in patients with Fuchs' patches of progression is statistically larger than the size of the scum in patients without Fuchs' patches. Fuchs' patches are particularly more often observed in grade III pterygium. Fuchs' patches (islets of progression) are more often present in patients with recurrent external eye scum. The presence of Fuchs' patches alongside pterygium represents seven times (6.62) more relative risk of recurrence in operated patients.

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## UPOREDNA ANALIZA KLINIČKIH KARAKTERISTIKA PTERIGIJUMA


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## SAŽETAK


**Istraživanje je sprovedeno s ciljem da se istraži međusobna povezanost kliničkih karakteristika pterigijuma (dužina trajanja bolesti, veličina, gradus pterigijuma, prisustvo Fuksovih mrlja i recidiv) i na osnovu njihove analize ukaže na mogućnost predviđanja pojave recidiva. Za potrebe istraživanja oformljena je grupa ispitanika od 55 bolesnika obolelih od pterigijuma, koji su operisani na Očnoj klinici u Nišu metodom po Arltu, gde je obavljen i kompletan klinički pregled. Anamnestički podaci uzeti su preoperativno. U okviru kliničkog pregleda, merenje veličine spoljašnje skrame oka izvršeno je milimetarskom skalom ručnog lenjira, a gradus je verifikovan biomikroskopom, metodom po Tanu. U cilju sagledavanja komplikacija i recidiva bolesti, kod svih bolesnika obavljeno je praćenje postoperativnog toka bolesti u trajanju od jedne godine. Pterigijum predstavlja spororastuću formaciju, što potvrđuje visoka statistička značajnost ($p < 0.001$) u korelaciji između njegove veličine i dužine razvoja. Sa porastom svoje veličine, pterigijum pokazuje i porast gradusa. Nađena razlika u veličini statistički je značajna ($p < 0.001$) između dva najudaljenija gradusa – I i III. Fuksova ostvca su statistički značano prisutnija ($p < 0.05$) kod većih pterigijuma. Prisustvo Fuksovih ostvaca uz pterigijum daje takvom procesu relativni rizik za nastanak recidiva od 6.62 puta više nego bilo koji drugi faktor. Uporedna analiza kliničkih karakteristika pterigijuma je dobra osnova za predviđanje pojave recidiva, koji predstavljaju najveći problem u lečenju ovog rasprostranjenog oboljenja.**



***Ključne reči:*** **pterigijum, Fuksova ostvca, oko**